Knowledge of Probability: Games Galore

Brief Overview:

Students will be able to make predictions based on the probability of random events by conducting various experiments. The use of problem solving strategies will aid students in identifying possible outcomes that occur while spinning a spinner, rolling number cubes and selecting items from a grab bag. With the completion of the lessons, students will be able to describe the likelihood of such events by using the vocabulary terms associated with probability. Application of this newly acquired knowledge will allow students to assess the fairness of a created scenario. Students will be evaluated on their knowledge of probability through selected responses and a brief constructed response.

NCTM Content Standard/National Science Education Standard:

Knowledge of Probability
Sample Space
Theoretical Probability

Grade/Level:

Grades 2 – 5

Duration/Length:

Four days (50 minutes each day)

Student Outcomes:

Students will:

- be able to predict and draw conclusions by conducting a probability experiment.
- be able to describe the likelihood of an event using appropriate vocabulary.
- be able to evaluate and determine fairness.

Materials and Resources:

- Transparency (Resources #1, #9)
- Blank transparencies/wipe-off boards
- Copies of all resource sheets - students
- Resource # 7 copied back to back
- Paper bags (About 10)
- Starburst candy (70-100 pieces)
- Poster (Resource #2, #6)
- Stickers

- Playing cards
- Paper clips (about 15)
- Students will need crayons
- Bingo markers/chips
- Internet access if possible

Development/Procedures:

Lesson 1 **What's in the Bag?**

Preassessment – Using the Think Pair Share technique, allow students to brainstorm prior knowledge about probability ideas, concepts and vocabulary. Ex. I know that spinners, number cubes and cards can be used to find probability. Probability is the chance of something happening etc. Each pair of students can be given a transparency or allowed to write on a chalk/wipe-off board in order to display and share the information and ideas they brainstormed with the class.

Launch –The students will each be given the title of "detective" in order to solve a paper bag mystery. They will be introduced to the concept by being shown a paper bag that contains seven pieces of candy. The colors of the candies inside the bag are orange, yellow and red. The student will be told that their goal is to draw a conclusion about the amount of each color of candies that is inside of the bag.

Teacher Facilitation – An example of the "What's in the Bag?" worksheet can be displayed on an overhead (RS#1). The experiment will be modeled to the class. Students will discuss the information regarding "What We Know" about the paper bag and the teacher can record these ideas on the sample worksheet. Ex. "I know that there are seven pieces of candy in the bag. There are red, orange, and yellow candies in the bag." The teacher will then draw one candy from the bag, show the class and place the candy back in the bag. This can be done up to seven times as tallies are recorded on the overhead. Using these results, potential color quantities will be discussed as the vocabulary terms likely, unlikely, etc. are introduced and displayed (RS#2). The students will be asked to use and apply these terms throughout the unit as well as on the summative assessment. Based on the results, the students will make several predictions about the quantities of each color candy. Ideas about "What We Think" will be recorded on the overhead, as a written response about the results will be modeled. Record these results on Resource Sheet #1. The

students will be shown the actual amounts of candies in the bag in order for them to compare the results to their predictions.

Student Application – The students will work in small groups to conduct an investigation independently. One of three different bags will be given to each of the groups. As "detectives" they will be given the task of determining whether they have been given Bag A, Bag B, or Bag C. A poster can be displayed with the three options (RS#3). Explain to the class that the students will each take a turn reaching into the bag to pull out a candy. Once the student has shown the group the piece of candy every member in the group must record the results on a copy of Resource Sheet #4. After recording the results of each pull, the student must return the candy to the bag and shake the bag to mix up the candies. Students are not to look inside the bag. Using the results of the experiment, the students must predict which of the three bags they have.

Embedded Assessment – The students will individually explain their conclusions in written form on the bottom of Resource Sheet #4. Remind the students to use the vocabulary terms. After responses have been written, the students may look in the bags to compare the results to their conclusions/predictions.

Reteaching/Extension –

- As students separate into groups those students who are struggling with the concept will remain with the teacher for additional modeling. The contents of the bag may be changed for reteaching purposes.
- Students in need of enrichment or extension to this activity will be given a new investigation (RS#5). A bag with changed variables (i.e. additional colors or amounts of candy) will be distributed for independent exploration. In this experiment the student must determine the quantities of each color candy in the bag. The student must then display his/her predictions through the creation of a bar graph (RS#6). The actual amounts should be checked in order to compare the data within a written response.

Lesson 2 **Number Cube Bingo**

Preassessment - Choose 5 different cards from a deck to show to the students. For example, you may display the Ace of Spades, Ten of Hearts, Four of Clubs, Queen of Hearts and the 2 of Diamonds. Ask the students, "What is the chance that you would pick the Ten of Hearts?" A correct answer would include the idea that the chances of

pulling that card are 1 out of 5 or equally likely. Ask students to orally list the possible outcomes for selecting each card. Have the students identify a card and describe their chances of selecting the card of their choice. Provide an opportunity for the students to select the cards they believe will have the highest likelihood of being chosen. Change the number of cards shown to the students or the amount of each individual card to change the chances of each outcome. This will lead to a discussion about the previous day's vocabulary and comprehension of these terms (refer back to vocabulary chart (RS#2).

Launch – Use this activity to make a transition to number cubes. Discuss with the students the numbers that appear on a number cube and the likelihood of each number being rolled. Pass blank bingo cards (RS#7) and chips/ markers out to the students (hint: cheerios make for very motivational chips). Inform students that everyone must place the numbers 2-12 in the blank squares. For the upper grades, this game can be modified to give additional practice in multiplication by using the numbers 6- 36. The students should place only one number per square. Each number can be used more than once, however, it is not necessary for every number to be used.

Teacher Facilitation – Once the students have filled each square with a number from 2-12 or 6-36, explain the directions and rules of the game. *Addition*: roll both cubes in order to find two addends. The students must then find the sum of those addends, ex. *2 + 3* = 5. *Multiplication:* roll both cubes to order to find two factors. The students must then find the product of those factors, ex. 4 x 6 = 24. If the sum or product of the problem appears on the students' cards, they may place one marker on that number. Only one marker is used per roll regardless of the amount of times the students have placed the sum or product on their cards. After playing two games, ask the students if any numbers appeared more often than others. This will lead the class into a discussion about whether some sums have a greater chance of occurring than others. Using the overhead transparency (RS#8) demonstrate the different combinations of addends that create each sum.

Student Application- After the class discussion, provide time for the students to either create a new card by choosing new sums or to continue playing on the same card. This will allow an opportunity for the students to demonstrate their application of vocabulary terms as well

as their understanding of the possible outcomes for the games.

Embedded Assessment – At the end of the class, the students will compare two bingo cards in order to determine which card displays the better probability of winning (RS#9). Responses will be written in the form of a brief constructed response.

Reteaching/Extension

- Students in need of reteaching can visit the following website: www.mathgoodies.com.
  - (go to students link and double click probability lessons)
- As an extension, students can play "Cube-O" again using either subtraction, or multiplication, or using three number cubes instead of two. (Additional cards would be needed) (SR#7)

Lesson 3 **Spin to Win**

Preassessment/Launch - Divide the students into groups according to a specific characteristic i.e. color of shirt, type of pants, type of shoes, color of hair, favorite color, etc. Once students are grouped, randomly select a group to be awarded a hypothetical prize. Lead a discussion about fairness with the students.

Teacher Facilitation – Have some students write their names on a small piece of paper and place all the papers in a container or bag (not all students will receive a piece of paper). Announce to the class that the person whose name is selected from the bag will hypothetically earn extra recess time. Discuss with the class the why this scenario is unfair to the students who do not have their names in the bag. Repeat this activity with the students while changing a variable i.e. allow some students to place their names in the bag more than one time.

Student Application - Students are each given a sticker (two of each sticker must be given out). Students then find their partner with the same sticker. Announce to the class that they will be playing the game, "Spin to Win." The students will be given a spinner divided into four sections and a paper clip (RS#10). Two of the sections will be marked as a blue, and two sections will be marked as red. However, the sizes of the sections will be unequal. Assign each student in the groups a color (blue or red). Model how to use the

spinner using a paper clip and a pencil. (Place the pencil through the paper clip with the point on middle of the spinner.) Using his/her finger, "flick" the paper clip. When the paper clip lands on a section the person who is assigned that color receives a point. The object of the game is for the players to attain as many points as possible. The person with the most points at the end will win the game. Students may be given approximately ten minutes to play the "Spin to Win" game while recording their results (RS#11). Each student should receive at least twenty chances at spinning the paper clip. If a group completes the experiment before that time, they may repeat the investigation again. Only this time, the player who was assigned the color red should play as the color blue and vice versa. Once the experiment is complete, lead a discussion about what characteristics are necessary in order for any game or experiment to be fair. For example, all players must have equal opportunity to win. This can occur when each color is equal in the amount of space it occupies on the spinner.

Embedded Assessment - Students will answer a brief constructed response based upon the results of the "Spin to Win" game (RS#11).

Reteaching/Extension

- Students will be given two blank spinners and asked to color the spaces to create fair/unfair games. Students will also be asked to explain what the difference is between the spinners (RS#12).
- Students in need of reteaching may return to an area where the teacher can model the above activity and complete it with guided practice.

Summative Assessment:

This assessment should be given on the fourth day of this unit. The students will be assessed on their understanding and application of the concept of probability as well as the vocabulary associated with this topic. This culminating activity will require the students to assess the fairness of an experiment through multiple-choice and a brief constructed response. (Summative Assessment Sheets)

Authors:

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What's in the Bag?

What We Know

η _____

_____

OUR EXPERIMENT RESULTS			
	Orange	Yellow	Red
Trial			

What We Think

η My prediction is that we have…

_____ Orange _____ Yellow _____ Red

η I think this because_____

_____

_____

_____

_____

_____

_____

What We Found

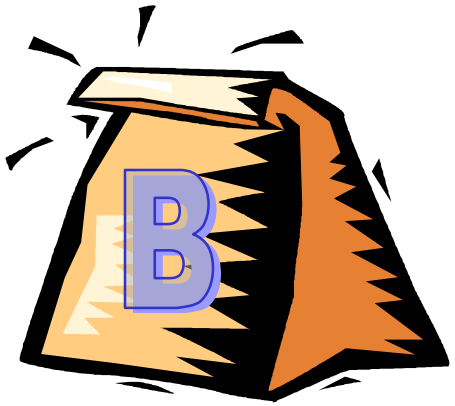
_____ Orange _____ Yellow _____ Red

Probability Concepts and Vocabulary

- Possible Outcomes
- Certain – Uncertain
- Likely – Unlikely
- Equally Likely
- More Likely – Less Likely
- Chance
- Probable
- Possible – Impossible

What's in the Bag?

Bag A:
2 Orange
4 Yellow
1 Red



Bag B:
5 Orange
1 Yellow
1 Red

Bag C:
2 Orange
2 Yellow
3 Red

What's in the Bag?

Name: _____ Date: _____.

What We Know

η _____

_____

OUR EXPERIMENT RESULTS			
	Orange	Yellow	Red
Trial # 1			
Trial # 2			
Trial # 3			
Trial # 4			

What We Think

η My prediction is that we have…

a. Bag **A** with 2 Orange, 4 Yellow, and 1 Red.

b. Bag **B** with 5 Orange, 1 Yellow, and 1 Red.

c. Bag **C** with 2 Orange, 2 Yellow, and 3 Red.

- I think this because_____

_____

_____

_____

_____

_____

_____

What We Found

- We have Bag _____.

What's in the Bag?

Extension Activity

Name: _____ Date: _____.

What We Know

η _____

_____

OUR EXPERIMENT RESULTS			
	Orange	Yellow	Red
Trial # 1			
Trial # 2			
Trial # 3			
Trial # 4			

What We Think

η My prediction is that we have…

_____ Red _____ Yellow _____ Orange

- I think this because_____

_____

_____

_____

_____

_____

_____

Actual Results:

_____ Red _____ Yellow _____ Orange

Using numbers and words, compare your prediction to your actual findings. Be sure to include the correct math vocabulary!

_____

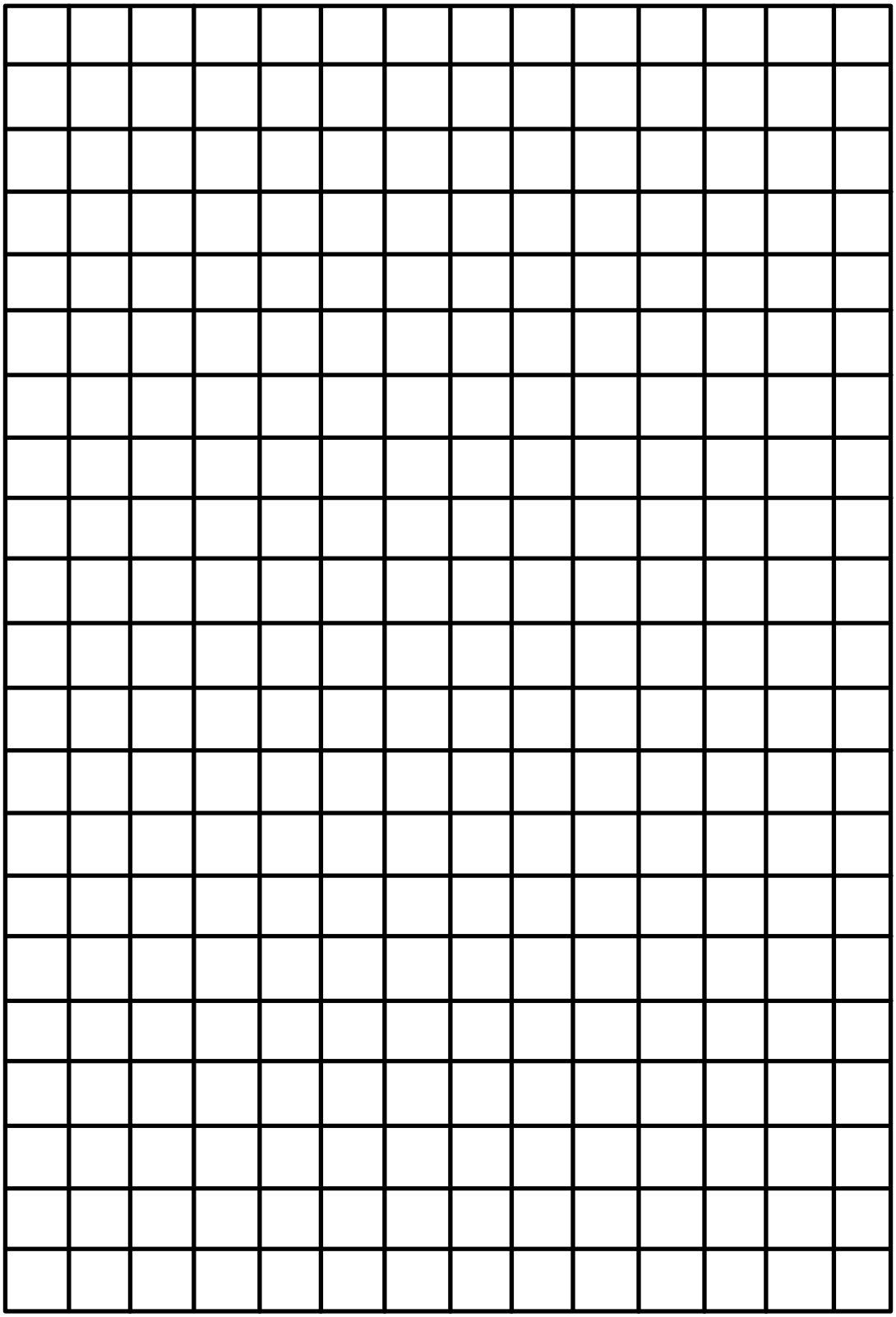
_____

_____

_____

_____

Title: _____



_____

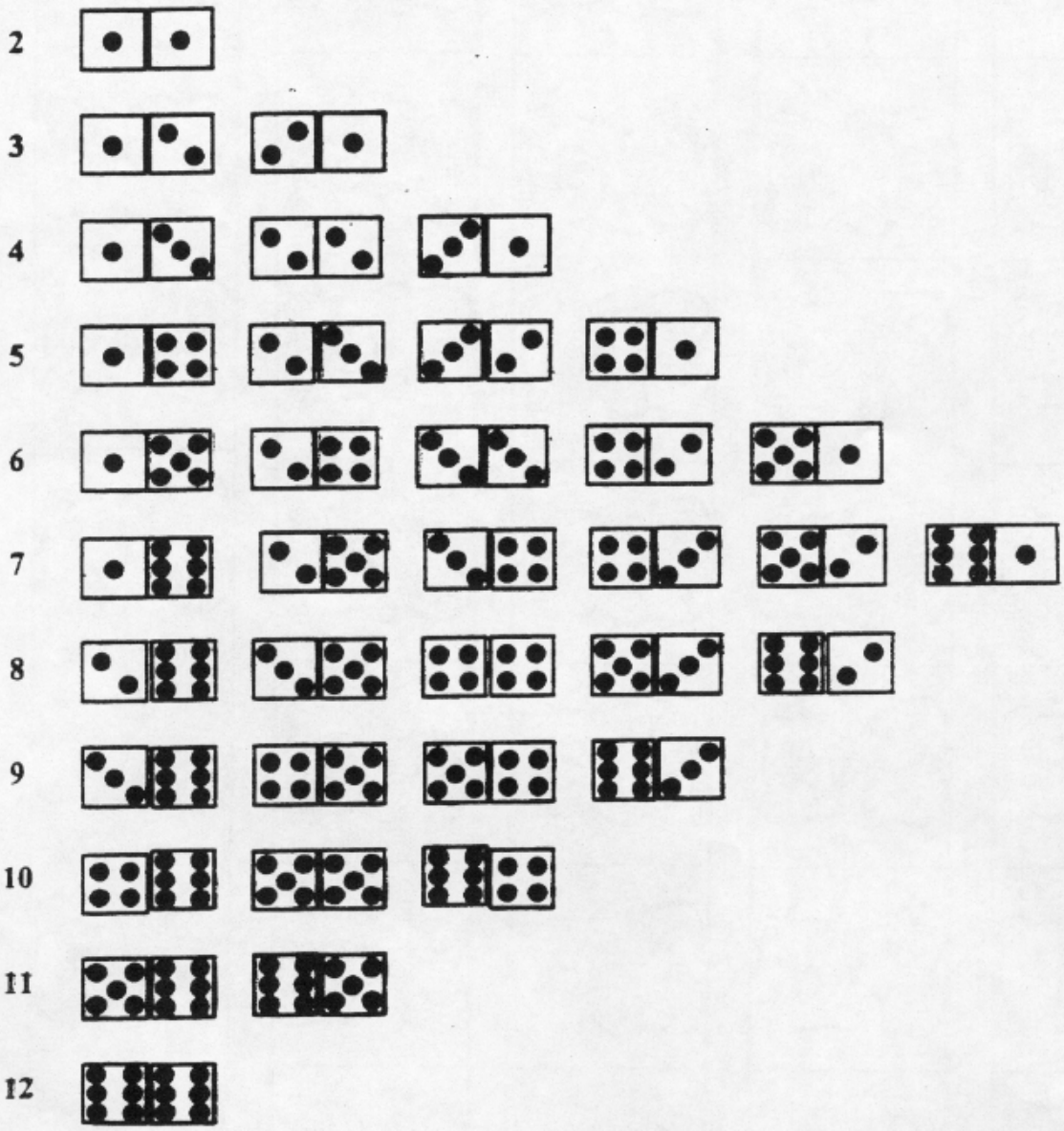
Author: _____

C u b e-o

		Free  Space		

Mathematics & NSA: A Long Term Partnership

NSA
Mathematics
Education
Partnership
Program



Experimenting with Chance

Name: _____

Date: _____

Playing Cube-O

Students in Mrs. Jacob's class made these two "Cube-O" cards.

Card A

2	12	7	5	12
11	9	3	10	2
4	12	Free Space	6	9
3	3	2	11	10
2	5	11	4	12

Card B

6	12	7	5	7
7	9	8	10	2
4	12	Free Space	6	9
8	6	2	11	10
5	9	7	8	12

1. Which card is more likely to win at "Cube-O"? _____.

2. Using number and words, explain why you chose the above card.

_____

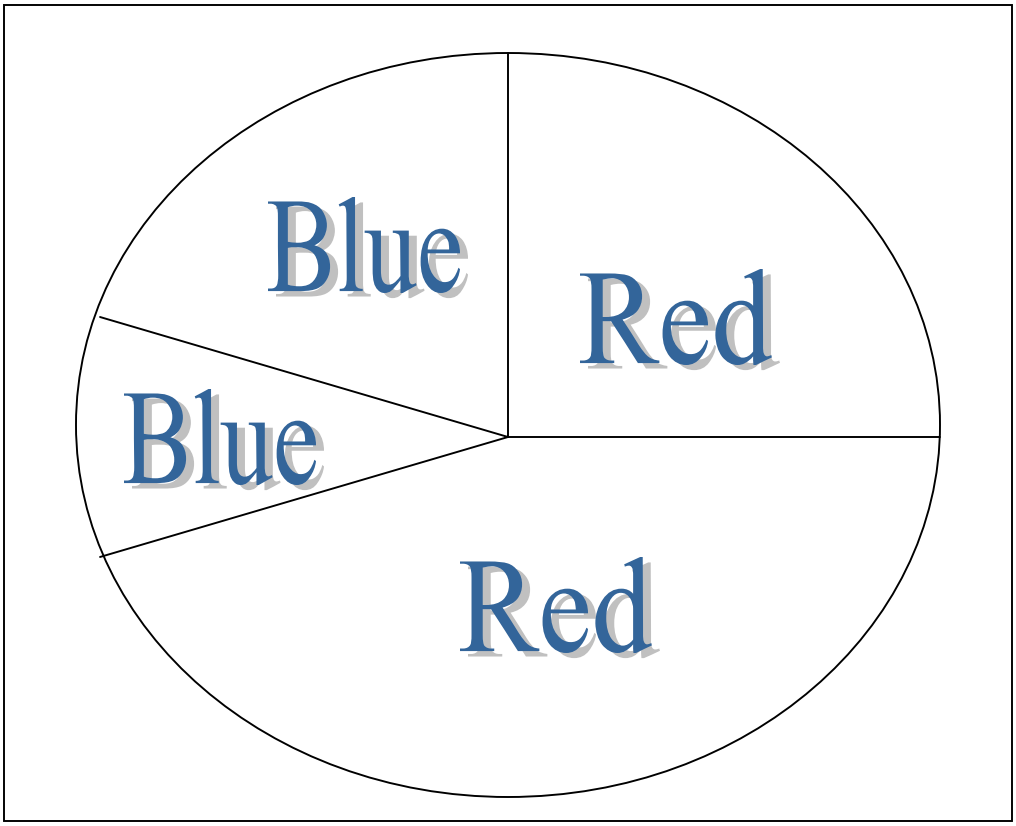
_____

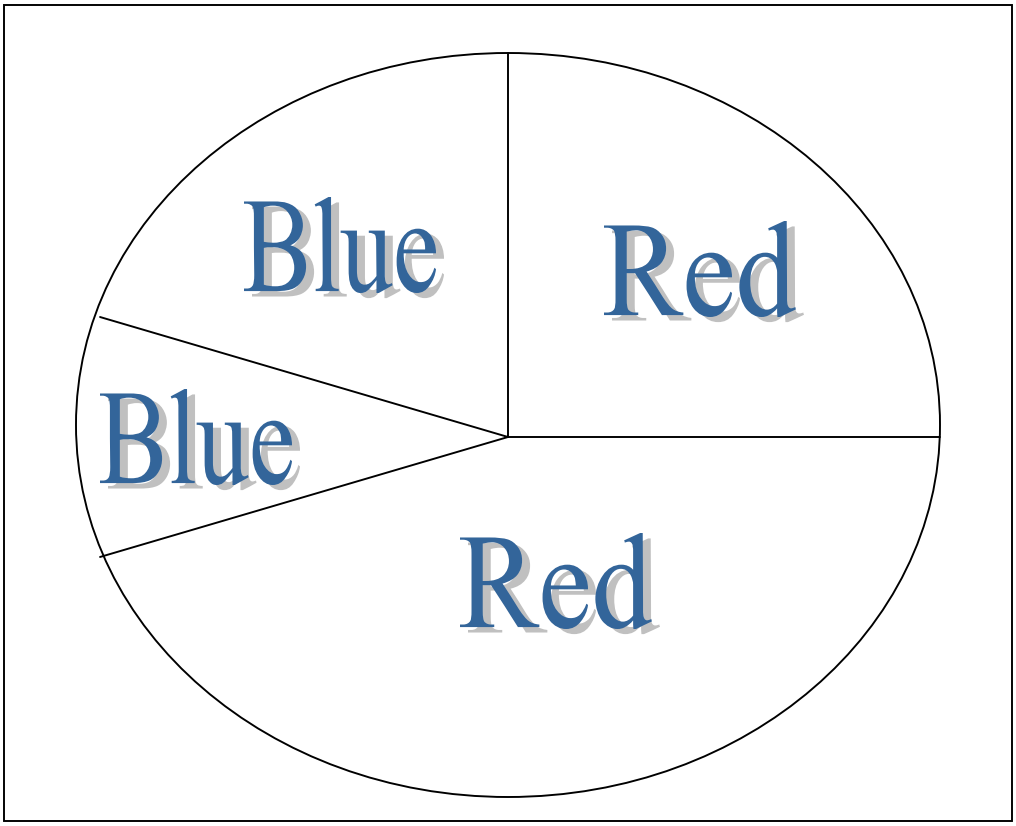
_____

_____

_____

Spin to Win Spinner





Spin to Win!

Blue	Red

Read the questions below and write the answer in the lines provided.

1. Which color on the spinner won the game? _____

2. Which color was more likely to win the game? _____

3. Explain using words and numbers why this color was more likely to win the game. Be sure to use a math vocabulary.

_____

_____

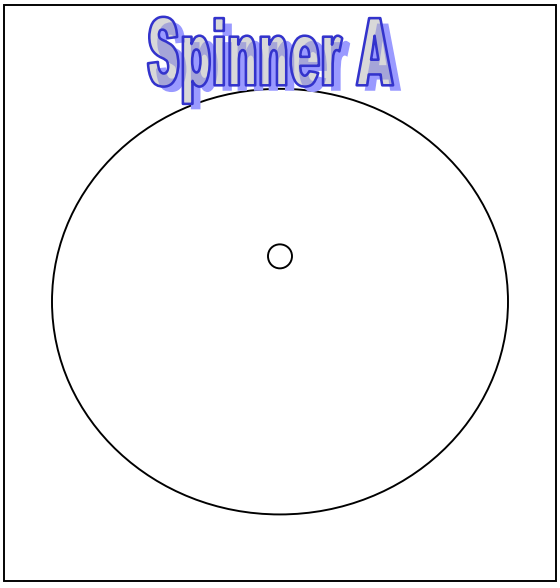
_____

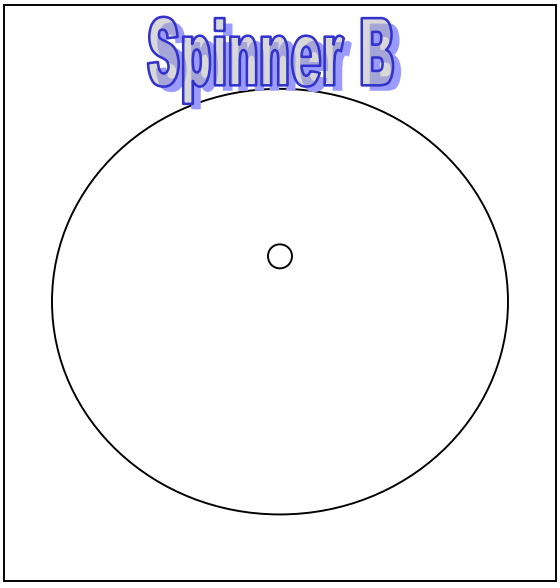
_____

_____

Spin to Win Extension Activity

You have been given the task of designing games for the second graders to play during the Spring Fling. However, not all of the games will be fair. You must make two spinners to use while playing the games. Use Spinner A to create a fair game. Use Spinner B to create an unfair game.





Use what you know about fair and unfair to explain why the spinners you created can be used to play each of the different types of games. _____

_____

_____

_____

_____

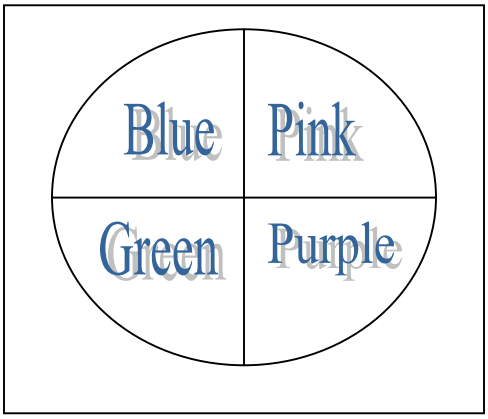
_____

Name _____ Date _____

Family Math Night

A. The school is having a "Family Math Night". All classes have been asked to create games for everyone to play. Take a look at the games below that a third grade class has created.

Game A



1. What are the possible outcomes of Game A?

_____

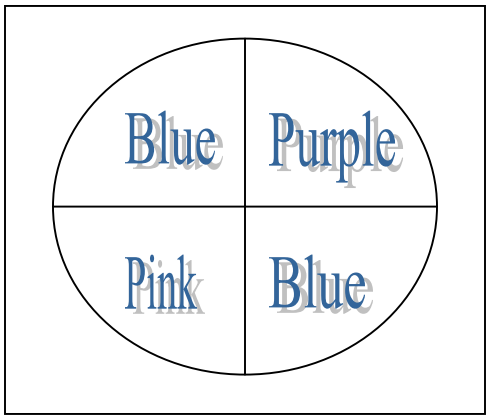
_____

_____

2. What is the likelihood that the spinner will land on purple?
   a. More likely
   b. Less likely
   c. certain
   d. equally likely

3. What is the likelihood that the spinner will land on orange?
   a. less likely
   b. impossible
   c. equally likely
   d. certain

Game B



1. What are the possible outcomes of Game B?

   _____
   _____
   _____

2. What is the likelihood that the spinner will land on Blue?
   a. less likely
   b. certain
   c. more likely
   d. impossible

3. What is the likelihood that the spinner will land on pink?
   a. certain
   b. more likely
   c. less likely
   d. impossible

The spinner game at “Family Math Night” needs to be a fair game. Take another look at Spinner A and Spinner B. Write a letter to the third grade class informing them which spinner they should use for “Family Math Night” make their game fair. Be sure to use math vocabulary in yo

Summative Assessment

Date _____

Dear Third Grade Class,

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Your friend,

_____

B. Directions: Use the chart below to answer the questions.

Mr. Smith bought a bag of 30 prizes for "Family Math Night". Each student will have an opportunity to select a prize from the bag. The chart below shows the prizes that are available to be won.

Bag of Prizes

Prize	Number of Prizes
Pencils	8
Stickers	10
Whistles	4
Balls	6
Toy cars	2

1. Which prize will most likely be pulled from the bag?
   a. pencils c. stickers
   b. toy cars d. balls

2. Which prize will least likely be pulled from the bag?
   a. toy cars c. balls
   b. stickers d. pencils

3. Devon wants to win either a pencil or toy car. Which prize will he be more likely to pull out of the bag? Use numbers and words to explain your answer.

   _____
   _____
   _____
   _____

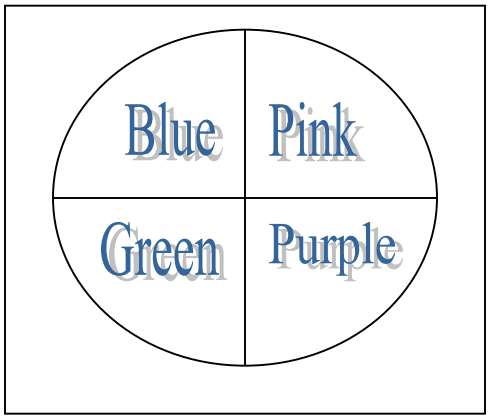
Name _____

Date _____

Family Math Night

A. The school is having a "Family Math Night". All classes have been asked to create games for everyone to play. Take a look at the games below that a third grade class has created.

Game A

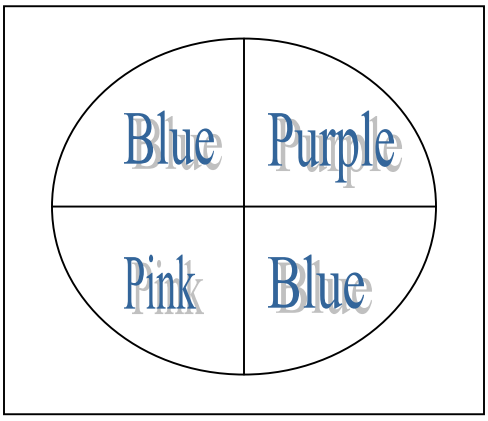


1. What are the possible outcomes of Game A?
   The outcomes are blue, pink, green and purple.

2. What is the likelihood that the spinner will land on purple?
   d. equally likely

3. What is the likelihood that the spinner will land on orange?
   a. im

Game B



4. What are the possible outcomes of Game B?
   The outcomes are blue, purple and pink.

5. What is the likelihood that the spinner will land on Blue?
   c. more likely

6. What is the likelihood that the spinner will land on pink?
   c. less likely

The spinner game at “Family Math Night” needs to be a fair game. Take another look at Spinner A and Spinner B. Write a letter to the third grade class informing them which spinner they should use for “Family Math Night” make their game fair. Be sure to use math vocabulary in your explanation.

Date _____

Dear Third Grade Class,

A well thought out answer should include the following:

- Choice of spinner A
- Explanation that Spinner A is fair because each color has an equally likely chance of being chosen.
- Use of mathematical terms such as fair, unfair, equally likely, less likely, more likely.
- Compares the similarities and differences of each spinner.

Your friend,

_____

B. Directions: Use the chart below to answer the questions.

Mr. Smith bought a bag of 30 prizes for "Family Math Night". Each student will have an opportunity to select a prize from the bag. The chart below shows the prizes that are available to be won.

Bag of Prizes

Prize	Number of Prizes
Pencils	8
Stickers	10
Whistles	4
Balls	6
Toy cars	2

1. Which prize will most likely be pulled from the bag?
   c. stickers

2. Which prize will least likely be pulled from the bag?
   a. toy cars

3. Devon wants to win either a pencil or toy car. Which prize will he be more likely to pull out of the bag? Use numbers and words to explain your answer.

Answer should include that Devon is more likely to chose a pencil out of the prize bag because there are 6 more pencils than toy cars. Students should use such words as more likely, less likely and equally likely.